PROBLEMS AND THEIR SOLUTIONS
IN
GROUND WATER RECHARGE ACTIVITIES
IN
SANTA CLARA VALLEY, CALIFORNIA

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A PAPER PRESENTED ON JUNE 28, 1961, AT THE BIENNIAL CONFERENCE ON GROUND WATER RECHARGE, BERKELEY, BY JOHN H. CLARKE, HYDROGRAPHIC ENGINEER, SANTA CLARA VALLEY WATER CONSERVATION DISTRICT, 15420 ALMADEN ROAD, SAN JOSE 24, CALIFORNIA.

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INTRODUCTION

The Santa Clara Valley Water Conservation District, since its organization in 1929, has been actively engaged in the provision of an adequate water supply for Santa Clara Valley. The availability of such a supply through ground water recharge has made possible an unprecedented growth of the Valley which has actually created an ever-increasing demand for water. While recognizing that a larger problem has been created by solving a smaller one, the District has concentrated its efforts upon

(1) making plans for the importation of supplemental water

(2) acquisition of additional water spreading areas

(3) increasing the efficiency of the present transmission and recharge facilities.

During the time permitted for this paper the latter two activities will be discussed.

ACQUISITION OF NEW SPREADING AREAS

It was realized that before supplemental water can be imported there must be means of diverting this water into the underground storage. In March, 1957, the voters of Santa Clara Valley approved a $3,000,000 bond issue to more than quadruple the existing 100 acres of spreading areas and to increase the capacity of and expand the existing distribution system.

The reason for acquiring the land for percolation at that time was that the rapid development of the Valley threatened either to include these areas or to cause land values to soar. Prospective percolation areas can only be located where nature provides the gravels.

Selection of the new spreading areas was made in this manner:

(1) The District's percolation measurement records were examined to see what existing stream beds could be developed into spreading areas.

(2) Well log data was obtained from local well drilling firms and well owners to determine location of gravel and overburden for off-stream ponds.

In areas where well log data was lacking, drilling was done by use of hand augers, power-driven test hole augers or rotary well drilling rigs.

The price paid for stream bed land was $1700 per acre, while off-stream land was secured for an average of $3575 per acre.

To date 315 acres have been purchased, while 61 acres are still under negotiation.

The design of the ponds has varied depending upon their location. Where stream beds have been used, all brush and gravel above stream bed level have been removed. The bottom of the widened stream bed cross-section has been designed to slope slightly toward the centerline. When the danger of winter run-off is over, gravel dams are constructed across the stream bed each year, varying in height from 4 to 10 feet. Wooden spillways with sand-bag approach wing walls are constructed in the creek bank to permit the flow of water beyond the dam to subsequent spreading ponds downstream. The dams are removed each winter.

The off-stream percolation ponds have been designed in a rectangular pattern with the number of cross levees being governed by the slope of the bottom of the ponds. Each pond is designed to spread water at depths of a minimum of one foot at one end and a maximum of six feet at the lower end. The entrance pond is designed as a sedimentation pond with baffle levees to cause the water to travel the greatest distance at very low velocity before reaching the first spreading pond. The water is conveyed through each spreading pond levee by means of corrugated metal pipe with hand operated headgates for regulation of the flow.

In one group of ponds located near Morgan Hill, California, there was a problem from wave action of the water against the pond banks containing clayey gravel which sluiced out the clay into suspension. The percolation rate decreased as the clay settled out to the bottom of the ponds. This problem was successfully solved by installation of log booms, made from used telephone poles, around the perimeter of the ponds to prevent the waves from reaching the banks.

CONCRETE LINING OF CANALS

Prior to 1957, most of the District's transmission system consisted of unlined canals. These presented many problems. Since the canals are located on hillsides, seepage losses have been the cause of damage to adjacent land owners. The earth banks have also been very attractive to vegetation which also contributes to decreased canal capacity and high maintenance costs. Rodent activity has in many instances been the cause of canal washouts.

In 1957 the District decided to concrete-line the canals in order to solve these problems. As an added benefit, increased canal capacities were attained and the percolation areas were kept in service for longer periods of time.

To perform this work the District purchased two concrete gunning machines. A total of 19.4 miles of canal were concrete-lined at a cost of 42 cents per square foot.

ELIMINATION OF AQUATIC VEGETATION IN CANALS

Another problem encountered was that the presence of aquatic weeds and algae reduced the flow below that of the designed capacity of the canals. The weed growth had caused the water level to rise, hence increasing the chance of overflow. The weeds collect silt and debris and occasionally break loose, clogging many canal structures.

The types of submersed and floating vegetation encountered were horned pond weed and moss.

Heretofore, this vegetation was removed by hand methods. Laborers would be assigned to dragging a chain along the wetted perimeter of the canal in an upstream direction to physically cut loose the vegetation. More laborers would be posted at each trash rack structure to remove the vegetation collected on the racks.

Shell Chemical Corporation had recommended the use of a new chemical herbicide under the trade name of Aquilan. Aquilan is a highly volatile liquid used as a plant cell toxicant.

In May, 1960, when the first vegetation of the season began to appear, the District used Aquilan for the first time with surprising success. After the results of the application had been observed, successive applications were made once each month during the months of July, August and September. After each application, it took about four days for the pond weeds to slough away from their root systems.

The method of application used is as follows: The flow in the canal was reduced from an average flow of 92 c.f.s. to 21 c.f.s. so that a minimum amount of Aquilan would have to be used and still have the vegetation submersed. The desired concentration was 30 ppm over a period of application of 2 hours and 42 minutes. The effect is that a blanket or wave of treated water is formed that moves downstream, bathing the weeds in toxicant.

The total length of the canal treated was 20.5 miles. Due to the length of the canal, the herbicide is "used up" as the blanket moves downstream from absorption by weed tissue and vapor loss. Therefore, the wave was "reinforced" at a second point of application. By the time the wave reached the end of the canal, the herbicide was "used up".

Below is a table showing a comparison of costs of hand cleaning methods used in 1959 as compared with costs of Aquilan application during 1960 and what a proposed application schedule would cost:

Hand-Cleaning Methods - 1959

February through April	$ 168.69
June through October	6651.57
	$6820.26

Aquilan Application - 1960

Month	Gal.	Chemical	Labor	Equipment	Total
May	55 gal.	$ 277.48	$ 40.57	$ 14.00	$ 332.05
June	None	Hand cleaning	Evergreen	Canal only	330.02
July	82 gal.	413.69	59.30	22.20	495.19
August	55 gal.	277.48	54.14	14.00	345.62
September	55 gal.	277.48	32.14	16.80	326.42

Proposed Schedule

Month	Gal.	Chemical	Labor	Equipment	Total
May	82 gal.	$ 413.69	$ 63.42	$ 22.43	$ 499.54
June	55 gal.	277.48	46.53	16.75	340.76
July	82 gal.	413.69	63.42	22.43	499.54
August	55 gal.	277.48	46.53	16.75	340.76
September	82 gal.	413.69	63.42	22.43	499.54
					$2180.14

Difference: $6820.26 - $2180.14 = $4640.12

The results of the use of Aquilan herbicide were very gratifying, with an annual saving of over $4,000 per year.

USE OF SEPARAN

Percolation in spreading ponds usually becomes impossible or very inefficient if the water contains appreciable suspended solids. This has been the case during storms and continues long into the spring months until much of the suspended solids settle out in the storage reservoirs. Sealing off the percolation pond gravel surfaces by use of the turbid water causes losses of percolation rates. Valuable time is lost during drying up and cleaning operations.

In March, 1959, Dow Chemical Company recommended the use of a relatively new chemical called Separan AP 30. Separan is a synthetic polymer designed as a floculating chemical to remove suspended solids from turbid water.

A test was conducted on March 23, 1959, in the open canal carrying water from Anderson Reservoir to Main Avenue Percolation Ponds located near Morgan Hill, California. The application apparatus was set up at a point 2000 feet upstream from the ponds. This point was selected since the canal enters an 18-inch pipeline permitting the necessary mixing of the

Separan and building of a floc before entering the sedimentation pond. This floc, composed of the union of Separan and the suspended solids, settled out in the sedimentation pond, and the relatively clear water flowed on into the percolation ponds.

The chemical application to the canal consisted of the mixing of a 0.5% solution of Separan AP 30 in a 55-gallon drum. A small gear pump on a variable-speed motor was used for metering the solution. It was distributed across the width of the canal by use of plastic tubing with five outlets and pinch clamps. The 0.5% solution was metered directly into the water with no further dilution.

The flow in the canal was 8 c.f.s. with the turbidity at the point of application at 618 ppm. When this treated water entered the percolation ponds, the turbidity was reduced to 91 ppm. The Separan treatment level used was 0.225 ppm. The treatment cost of this turbid water was calculated at 61 cents per ac. ft.

The District was gratified with these results and thereby designed and installed stationary application apparatus at the Penitencia Percolation Pond diversion dam located about five miles east of San Jose, California. This selection was made since no impounding reservoir is located on Penitencia Creek and therefore it had presented the District with most of the turbidity problems. However, there was no opportunity for use of Separan since 1959 because of sub-normal rainfall and run-off.

CONCLUSION

It is hoped that this coming winter will produce normal or above-normal rainfall so that more accurate cost data can be developed on the use of Aquilan and Separan.